LETTERS TO THE EDITOR.

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The Principle of Relativity

IN reading through Mr. Cunningham's article on "The Principle of Relativity," I have been struck by several points which seem to require some elucidation. Whether these difficulties are inherent in the "principle of relativity" as it is generally understood, or whether it is merely owing to the fact that for some time I have been accustomed to look at the matter from a different point of view, which I believe solves these difficulties, and that, on this account, I am rather obtuse towards other views, I cannot say.

Some of these points may be best indicated by Mr. Cunningham's own words, as follows:—

(1) "Now the very first thing that appears, if we accept the hypothesis of relativity, is that it is impossible for us to determine uniquely whether two events are or are not simultaneous."

(2) "We find that the conception of 'simultaneity' does not become definite until we have assigned a definite velocity to a certain point."

Query—What is a "definite velocity"? Is it to be defined in terms of length and time in the usual way, and, if so, how are length and time to be measured? For, as Mr. Cunningham remarks:—

(3) "The next thing we may notice is that the notion of the 'length of a body' becomes indefinite along with the term 'simultaneous.'"

(4) "If now we start from the fundamental law that there is a definite physically-determined velocity, that of light. . . ."

Query—What does Mr. Cunningham mean by a "definite physically-determined velocity" in view of statements (1), (2), and (3)?

Things apparently indefinite:—(1) "Simultaneity"; (2) mode of measuring length; (3) mode of measuring time intervals; (4) meaning of velocity.

Query—What are Mr. Cunningham's fundamental concepts?

A. A. ROBB.

Cambridge, June 20.

IT should be fairly clear that the articles referred to by Mr. Robb were written with the intention of showing the need for a revision of the common ideas about space and time, which discussions on the principle of relativity have shown to be deeply ingrained. Mr. Robb would be the first to admit that such a revision is a necessity. The passages quoted above—(1), (2), (3)— were written to emphasise it.

To Mr. Robb's first query it must be replied that in the conceptual scheme of relations which we have evolved out of the data of perception, velocity is defined in terms of length and time in the usual way; but unfortunately experiment has not enabled us to think out a unique way of "measuring" space and time.

To the second query it need only be said that it is universal to think of light as being propagated in time, that this propagation is determined by physical considerations, and that it is at any rate a possible hypothesis that in the conceptual representation of the phenomena this propagation takes place always at a definite rate.

To the third query the reply is that the fundamental "concepts" in the representation of physical phenomena are space and time.

But the articles did not profess to describe in detail a logical scheme of the universe of motion. Mr. Robb's forthcoming work in which this is attempted is anticipated with much interest.

E. C.

Distribution of Rainfall on Sunday, June 14.

I AM endeavouring to trace out the distribution of the rainfall on Sunday, June 14, in a similar manner to that in which I investigated a thunderstorm some three years ago. May I ask anyone who is interested, and has not already communicated with me, to send as full details as possible either to me or to the British Rainfall Organisation, 62 Camden Square, N.W., unless they would report in due course to the Meteorological Office or to the Royal Meteorological Society?

Especially should I like information on the following points:—When the rain began; when it fell or did not fall; whether there was hail; if so, when and for how long; whether there was wind, and from what directions. It would add to the value of the facts if the precise point of observation were stated.

Information is desired as to the weather outside the storm area, as well as to the conditions where rain fell.

Any observations, however slight, even if they refer only to one particular time, will be welcome and useful.

J. FAIRGRIEVE.

London Day Training College (University of
London), Southampton Row, London, W.C.,
June 26.

The Photo-electric Effect of Carbon as Influenced by its Absorbed Gases.

THE existing contradictory results on the photoelectric effect of carbon can be explained by means of the quantity and quality of the gases absorbed by the carbon. The influences of ammonia, hydrogen, air, and carbon dioxide were investigated. The most consistent results were obtained from carbonised bamboo and hydrogen. Saturation curves showed ammonia to be the most active, and carbon dioxide the least. Distribution of velocity curves were obtained for bamboo and hydrogen. The maximum initial velocity was found to be independent of the quantity of hydrogen absorbed, while the maximum current was proportional to the quantity of gas absorbed.

O. STUHLMANN.
R. PIERSOL.

University of Pennsylvania, June 17.

MAYA ART.[1]

EXCEPTING the splendid labours of A. P. Maudslay, embodied in four volumes of beautiful illustrations, with a descriptive text, the study of old Maya civilisation is almost entirely German-American, and it became a science through Foerstemann, who, with marvellous intuition, was the first to read some of the glyphs.

It is a study quite self-contained, fascinating, but leading apparently nowhere. When the Spaniards conquered Middle America, the Maya glory was already a thing of the past, whilst the Mexican civilisation was at its height. This also has vanished without in the slightest degree having influenced the present civilisation, which is entirely Spanish, certainly Latin. The natives neither know nor care anything about the monuments of their ancestors, more often than not they do not even consider them as ancestral, but merely as relics of the olden times. Christianity —and they are nearly all nominal Christians—has smothered, or ruthlessly destroyed, the old life and its traditions. Idolatry being forbidden by law, it is practised more or less secretly, and many old heathen rites have been cleverly woven into the orthodox practices of the Church, especially with the celebrations of the numerous feast days.

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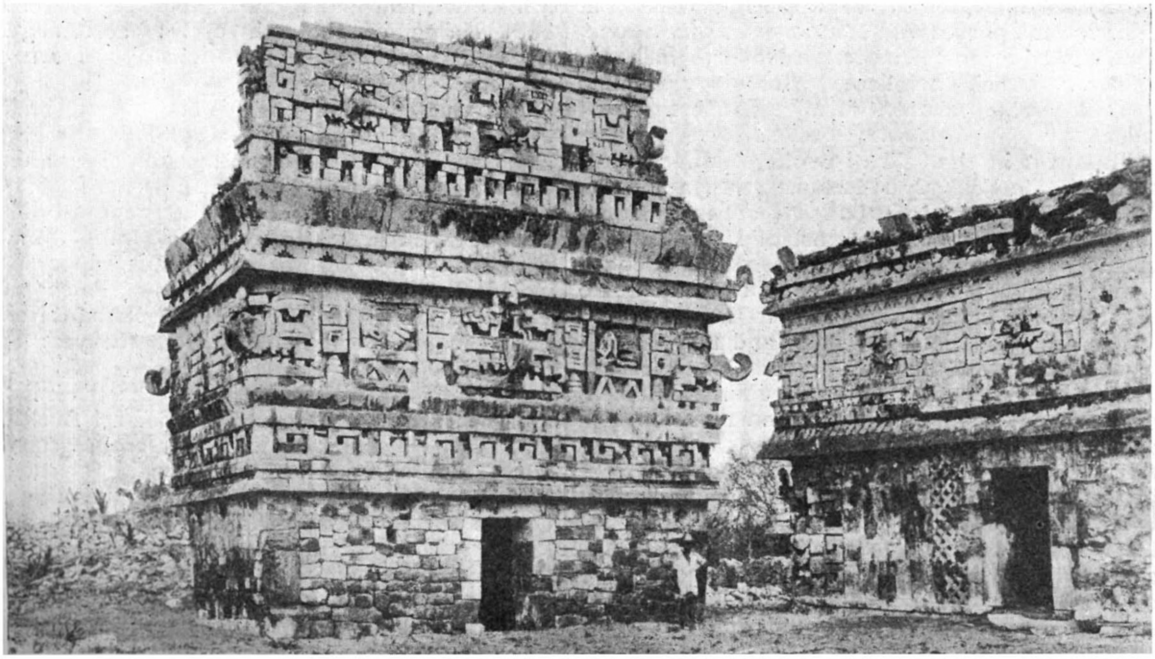
[1] Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. vi. A Study of Maya Art: Its Subject Matter and Historical Development. By H. J. Spinden. Pp. xxiii+285+29 plates+map. (Cambridge, Mass; Peabody Museum, 1913.)

The ancient eastern civilisations from Egypt to India and China are more or less akin, have influenced each other, and their effect lasts into our own present-day life. Almost any Mesopotamian find is sure to throw some light upon the history of the European-Asiatic communities. Nothing of the kind applies to America. If it had been found uninhabited by the Europeans, that would in the long run have had no effect upon the culture and thoughts of the rest of the world. As it happened that there were natives, they have been used as beasts of labour. They were sweated, but not more than the Aztecs had sweated and raided the other tribes.

Dr. Spinden is a pupil of the active and flourishing School of American Archæology, under the guidance of Dr. Tozzer, at Harvard University. His most noteworthy contribution in the present volume is the exposition of the archæological sequence of the Maya monuments.

Who are the Mayas? Maya-speaking people inhabit the Mexican States of Tabasco, Chiapas, and Yucatan, south of the Isthmus of Tehuantepec, besides Guatemala and Honduras. To the north and west this larger Maya area adjoins those of the Zapotecan (Mitla) and Nahoan or Mexican civilisations.

It seems most probable that the mysterious Toltecs were those Mayas in a wider sense, who, in prehistoric times, had extended on to the plateau of Mexico, raising there the great pyramids of Teotihuacan, Cholula, etc. Then the Nahoa, coming originally from the north and west, drove out the Toltecs, and themselves gradually became civilised, building upon the inheritance, the longer they remained in contact with the Toltec-Maya crafts, arts, and science, which continued to flourish in the far south-east. Even so late as shortly before the Spanish conquest the Aztecs or Mexicans proper were sending military colonies down to Nicaragua. Spinden accepting this view, considers the pre-Aztec monuments on the plateau as contemporary with what he designates as the brilliant period of building in Maya-land; the fine Aztec and Zapotec buildings arose later.



The "Church" at Chichen Itza in Yucatan.

The ethnology is very doubtful; anything before 1325, the generally accepted date of the foundation of the city of Mexico, is fictitious. The Codices, illuminated manuscripts, are picture-writings, a compound of idiograph-pictures, and phonetic writing, just on the verge of the invention of an alphabet. It is a highly developed art of pun-drawings, or rebus. Whilst the Nahoa codices—they were nearly all almanacs, or memoranda of accounts—are easy to read, so far as names of places and numbers are concerned, those of the Maya had far advanced, the pictures having been condensed into much conventionalised signs, and nothing but cyphers and sums have been made out with some certainty. The rest is guesswork, run wild.

The Nahoa, Zapotecs, and Tarascans had risen to kingships, but the Maya were split into many small tribes, independent, and each under its own hereditary chief, a condition of things which makes it difficult to account for the splendour and size of the temples and other public buildings, unless, as Spinden suggests, the old Maya, like the Greeks, were religiously and artistically a nation, but politically a number of small sovereign States. Little is known about their religious ideas. They worshipped many deities—above all, one represented by the plumed serpent, with endless symbolic variations. The ceremonials centred in processions, incense-burning, and human sacrifices, the victims being supplied by raids. The ritual, the appeasement of the many deities in their various phases and imagined manifestations, necessitated a most elaborate calendar, which, together with their complicated chronology, implied a considerable amount of astronomical knowledge.

Foremost in the field of work at Mayan antiquities is the Peabody Museum. "Maya art was on a much higher scale than any art in America, except, possibly, the textile art of Peru." "The ancient masterpieces of Yucatan and Central America show a fine technique and an admirable artistic sense, largely given over to the expression of barbarous religious concepts, and they furnish many analogies to the early products of the classic Mediterranean lands. Indeed, upon such technical grounds as fore-shortening, composition, and design, Maya art was in advance of the art of Assyria and Egypt, and only below that of Greece in the list of great national achievements." But whilst the Greeks apotheosised the human form, the Maya gods and heroes had fundamentally the characteristics of reptiles, birds, and beasts, more or less humanised grotesque figures, often smothered, overpowered by the detail of symbolical attributes.

Painting in colours upon paper and excellent plaster, carving in wood and stone, modelling in clay and stucco, low and high relief, and full round, were much practised, and these people would have accomplished more if they had risen to iron and bronze chisels, instead of implements of stone and obsidian, and if the country had supplied them with marble instead of a coarse and uneven limestone.

Our author has arranged the numerous principal monuments of Copan in Honduras upon a primarily stylistic principle. They fall into four chronologically successive stages, but it is to be remembered that a new type of stela, for instance, was well begun before the old type was abandoned, so that there is a considerable overlap; provided always that their Maya dates have been correctly interpreted, which is by no means always the case.

First: the stelæ show glyphs of archaic form, and in low, flat relief. Altars are drum-shaped, plain, or with rudely carved ornamental symbols.

Second: the stelæ are sculptured, with gradually higher relief. The face of the figure is that of an animal. The head-dress of the figure consists of the face of an animal. The heels stand together, with toes turned outward, forming an angle of 180°.

Third: the stelæ are sculptured. Grotesque faces with turban-dress.

Fourth: stelæ sculptured, practically in full round, with considerable modelling of face and limbs, which assume a less awkward position. Elaborate head-dress with feather-drapery. The altars represent two-headed dragons or serpents, a turtle, or a couple of grotesque jaguars.

The whole development at Copan comprised only 276 years, beginning with the 11th tun of the 4th Katun, and ending with the 10th year of the 18th Katun of the 9th cycle; according to Spinden's assumption from about 250 A.D. to 525 A.D.

For Guatemala and Honduras, where, besides others, the famous monuments of Tikal, Quirigua, and Copan are situated, he distinguishes, after a proto-historic period, an archaic period from 160–755 A.D., upon which follows the great or brilliant period which lasted to about 600 A.D. For no particularly binding reasons this is supposed to include the wonderful monuments of Palenque in Tabasco. After some transitional period a Nahoa period in Mexico is fixed at from the year 1195 onwards.

From this it will be seen that the tendency to assign a sensational age to the Central American monuments has given way to more reasonable views, although our author goes quite far enough back when he puts the beginning of the 9th cycle at 160 A.D., whilst others are satisfied with a date several hundred years later.

It may not be amiss to make a few explanatory remarks about this Maya chronology. They had a ceremonial almanac of 260 days; twenty sections of thirteen days each; twenty day-signs of animals and other natural objects, combined in a certain order with the numerals 1–13, so that every one of these 260 days had an absolutely fixed name, number, and position. They reckoned by scores, whilst the number 13, as Foerstemann discovered, is based upon the fact that eight years of 365 days are exactly five years of the planet Venus, which they worshipped. This curious almanac is, in fact, based upon a combination of terrestrial and Venus years.

They had further a civil year of 360 days, called a *tun*; twenty tuns are a *katun*, and twenty katun a cycle or big period. Now, if every score of years is designated by a name-day of the ceremonial almanac, 260 katuns can be fixed without repetition, *i.e.* 5200 years of 360 days. If this unwieldy number is subdivided by a score of scores, 400, there result thirteen cycles. Foerstemann has further discovered that the zero of the whole reckoning system refers to a day, which in this almost perpetual calendar is a 4 Ahau katun, which begins with the eighth day of the score called Kumku. This has therefore been called the normal or zero date, from which all the monumental dates reckon in days, scores of days, years, scores of years, and cycles. Astronomers do not seem to have taken up the question whether this zero-date, which lies somewhere near 3000 B.C., may possibly refer to some remarkable planetary configuration. It may, however, be altogether fictitious. Very little is known about their cosmogony, and it is not known why they should have considered themselves in the ninth cycle of their world's history when they constructed the Quirigua and Copan monuments. This mode of reckoning was still used at the Spanish conquest, but as they had not invented a leap-year correction they occasionally shifted their new year's day to make the religious feasts tally with the actual seasons. But since it is not known when such shifts were made, and since the various nations did not interpolate alike, none of the numerous dates can be determined.

Most of this American archæology is still in the descriptive stage. For instance, the less there is known about the reason why the chief deity, or hero, Kukulcan or Quetzacoatl, the Great Plumed Serpent, is thus represented, the more minutely he is described and figured wherever a fragment of him is found. We can see that it is a snake. But the answer to the pertinent question: Why a serpent? That there is no particular reason except that "the body of a snake combines readily in art with certain characteristic parts of other animals," that it lends itself especially well to design and ornamentation, is rather disappointing.

H. G.

BIRDS AND WEATHER.[1]

THE difficult question of the influence of meteorological conditions on the phenomena of bird migration has fortunately been very thoroughly studied as regards the British area, but we are none the less glad to welcome the recent labours of Dr. Defant on this subject. Dr. Defant as a meteorologist has submitted to a critical examination the data collected some years ago regarding the spring arrival in Austria of some thirty species of birds. He has selected four species for special treatment, and the data cover a period of seven seasons (1897–1903). The published weather reports have supplied all the necessary meteorological data for the corresponding periods.

At the outset of his paper Dr. Defant points out that, while all meteorological factors must be taken into account, the relation of all other conditions to that of atmospheric pressure renders possible a concentrated attention on the latter. A comparison of the ornithological data with the temperature records gave a purely negative result, no direct relation being discoverable. Dr. Defant also rightly insists on the importance of considering the weather of the whole of southern Europe, the conditions prevailing in the actual area of arrival being obviously less important than those in the regions immediately to the south through which the migrants must pass.

The spring immigration of the starling and the lark are treated together, these species showing a detailed similarity in this aspect of their seasonal movements. Tables are given showing that there is an annual variation both in the earliest date of arrival and in the duration of the influx. The period of heavy immigration usually lasts about eight days and the average date of maximum arrival for the seven years was February 23, while the average dates for particular years varied from February 12 to March 3.

With the partial exception of one year out of the seven it was found that the periods of maximum immigration coincided with periods of low atmospheric pressure in the west and north-west of Europe and higher pressure in the south, south-east, or east. These conditions give southerly or south-easterly winds in Austria and the countries immediately to the south, and usually rising temperatures. The immigration was all the greater when these favourable conditions had been immediately preceded by a prevalence of high pressure in the north and north-west (or north-east) and low pressure in the east or south-east; such conditions usually entail low temperatures and northerly or north-westerly winds.

Dr. Defant then considers the average daily pressure for the three regions into which he divides southern Europe. These are A = western Asia Minor, the Balkan Peninsula, the Adriatic Sea, and southern Italy; B = the remaining greater part of Italy, the western Mediterranean and northern Africa; and C = Spain and Portugal. The last-named region is soon shown to be irrelevant, and Dr. Defant's second conclusion results from a comparison between A and B. He finds that strong immigration in Austria occurred when the pressure in these regions was relatively higher than on the days immediately before and after and when the pressure in A was higher than in B. The east to west pressure gradient thus formed when coupled with the effect of the earth's rotation produces the south-easterly winds characteristic of the type of weather already described as favourable to migration.

The cuckoo and the house martin are then treated in like manner (not jointly as in the previous case, but simultaneously to economise space in tables and graphs). The same two conclusions are arrived at for these immigrations occurring much later in the season than that of the starling and the lark. A second type of weather was also found favourable in the case of the cuckoo, namely, extended high pressure over the whole of central and southern Europe, usually with weak easterly or north-easterly winds. In seasons

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[1] "Der Einfluss des Wetters auf die Ankunftszeiten der Zugvögel im Frühling." By Dr. A. Defant, Vienna. Reprinted from *Schwalbe*, new series, vol. iii., 1913, pp. 135–56, and charts.